Proceedings of the Workshop on CONCEPTUALISATION DESIGN & DEVELOPMENT of INTERACTIVE EXHIBITS

August 03 - 12, 2009

Organized by:

Central Research & Training Laboratory

(National Council of Science Museums)
33,Block-GN, Sector-V, Bidhan Nagar, Kolkata- 700 091.

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(www.ncsm.gov.in; www. ncsm.org.in)

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Introduction

National Council of Science Museums (NCSM), functioning under the Ministry of Culture, Govt. of India, is the apex body of all Science Museums & Centres under Govt. of India and is engaged in popularizing science and technology among the common people and to create scientific awareness in the society.

The principal mode of science popularization by NCSM is through the interactive exhibits as it is strongly believed by educationists world over that science and technology learning can be best achieved through hands on experience. In order to innovate new methods and techniques in development of interactive exhibits, NCSM periodically organized brain storming sessions on exhibit development.

In view of this, a workshop on conceptualization, design and development of interactive exhibits was organized during August 03 – 12, 2009 at **Central Research & Training Laboratory (CRTL),** Kolkata, a constituent unit of NCSM engaged primarily in R & D and HRD activities. Twenty one participants including Curators of NCSM and participants from Tamil Nadu Science & Technology Centre, Chennai, Birla Museum, Pilani and National Science Museum, Yemen took part in the workshop. The workshop was also attended by senior Curators from other units of NCSM.

The participants were divided into four groups and were given several topics on which brain storming was done in conceptualization, design and development of new interactive exhibits. After a series of discussions, a few exhibits were shortlisted for final design and prototypes were made of one exhibit by each group. On the concluding day, each team made their presentations with final drawing. The details of the exhibits are given in the following pages. It was resolved that the participants will further develop the exhibits and the same will be finally included in NCSM's list of interactive exhibits.

The participants paid an educational visit to Bardhaman Science Centre on August 9, 2009. The workshop concluded on August 12, 2009.

Programme

Date	Session-I (1000 hrs. - 1330 hrs.)	Session-II (1430 hrs. - 1730 hrs.)
3.8.2009 (Mon)	• Introductory session • Remarks by DG, NCSM • **Exhibits** – A brief presentation by Director, CRTL • A presentation by Director, Science City • A presentation by Director, BITM • Group formation	• Topic allocation • Finalization of sub topics
4.8.2009 (Tue)	• Conceptualization / interaction regarding exhibits designed by participants	• Conceptualization / interaction regarding exhibits designed by participants - **Presentation**
5.8.2009 (Wed)	• Conceptualization / interaction regarding exhibits designed by participants	• Conceptualization / interaction regarding exhibits designed by participants - **Presentation**
6.8.2009 (Thurs)	• Presentation of preliminary ideas/design and discussion by participants of Group-A and Group-B.	• Presentation of preliminary ideas/design and discussion by participants of Group-C and Group-D.
7.8.2009 (Fri)	• **Short-listing** and **finalization** of exhibit ideas of Group-A followed by interactive discussion including finalization of list of materials for development of exhibits.	• **Short-listing** and **finalization** of exhibit ideas of Group-B followed by interactive discussion including finalization of list of materials for development of exhibits - **Presentation**
8.8.2009 (Sat)	• **Short-listing** and **finalization** of exhibit ideas of Group-C followed by interactive discussion including finalization of list of materials for development of exhibits.	• **Short-listing** and **finalization** of exhibit ideas of Group-D followed by interactive discussion including finalization of list of materials for development of exhibits – **Presentation**

9.8.2009 (Sun)	- Study visit to **DSC, Bardhaman**	
10.8.2009 (Mon)	- Fabrication of prototype of two exhibit ideas by participants in the workshop.	- Fabrication of prototype of two exhibit ideas by participants in the workshop continues.
11.8.2009 (Tue)	- Testing of prototypes/interaction and finalization.	- **Label writing** of prototype exhibits and evaluation. - **Study visit** to Science City (1730 hrs. – 2000 hrs.) followed by dinner.
12.8.2009 (Wed)	- Presentation of **final report** by participants	- Presentation of final report continues – **summing up** and **concluding session**.

List of the Participants

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Preliminary ideas

Group A

1. Memory:
    - Test for memory
    - Memory retrieval (recapitulation)
    - Anatomy of Memory

2. Symmetry:
    - Concept of Symmetry – (Rotation of different objects wrt different axes)
    - Are we Symmetrical?
    - Enuntiomers - optical isomers

3. Encryption:
    - Concept of encryption
    - Computer encryption
    - Letter encryption
    - Encryption by reflection

4. Artificial Intelligence:
    - Colour Sensing Car
    - Automatic Speed Control Traffic Signal
    - Smart Home

5. Eccentricity:
    - Eccentric Wheel
    - Eccentric Mono-cycle
    - Eccentricity of conics
    - Drawing ellipses of different eccentricities ($0<e<1$)

6. Measurement:
    - Know your height
    - Degree of accuracy

7. Scales:
    - Equal temperament scale
    - Distorted room
    - Biological size spectrum – logarithmic scale

   - Time scale (Why clocks have 2/3 hands, and not a single hand)

8. Eclipse:
   - Transit, occultation and Eclipse
   - Solar Eclipse (How & When, duration)
   - Lunar Eclipse

9. Communication
   - Multiplexing and Band width

Group B

1. Stability
   - Centre of Gravity
   - Simulation of Human Balancing Mechanism (Vestibular Organs)
   - Weight on your back
   - Super Elevation
   - Steering a Bicycle
   - Can you Stand Up?
   - Building with Overhead Water Tank
   - Building with Pendulum to dampen vibration

2. Hydraulics
   - Sinking of Ship
   - Passing under a bridge
   - Lift yourself
   - Cartesian Diver

3. Rotating Bodies
   - Moment of Inertia/ Centrifugal Force
   - Centrifugation
   - Standing of Disc on a rotating Dick
   - Energy & Orbit

4. Weightlessness
   - Modified Version with Light

5. Mechanics

- Friction: Less or More
- Sliding & Rolling
- Effect of Lubricants
- Trolley with Rollers

6. Projectile
    - Horizontal Range

7. Force
    - Pulling the weight (Sc park)

8. Inertia
    - Air table with computer simulation

9. Pattern in the nature
    - Leaves Pattern
    - Space Optimization
    - Fractals
    - Tessellation
    - Fibonacci number

Group-C

1. Heat:
    - Thermal expansion
    - By thin plate with Laser.
    - Expansion of bimetallic strip
2. Buoyancy:
    - Visualizing buoyant force
    - Dropping same weight through different liquid
    - Feeling buoyant force
    - Lifting same weight through different liquid
3. Viscosity:
    - Viscous drag (terminal velocity)
    - Dropping balls of same weight helical guide placed in different viscous media
    - Viscous Flow
    - Flow of different viscous liquid in to chambers filled with granules
    - Feel the viscosity

4. Atomic physics
5. Colour:
    - Michelson interferometer
    - Diffraction of light using different diffraction grating
    - Total internal reflection (Prism)
    - 8 bit colour scheme
    - How animal see colour
6. Valency:
    - Understanding valency with matching pattern/blocks
7. Vacuum
8. Scattering of Light
    - Green Laser scatters in different media

Group D

1. Environment
    - Carbon Emission
    - CO_2 level time line
    - Different options to know our carbon footprint

2. Climate change
    - Sea level rise
    - Memory in Tree Trunk
3. Water
    - Water! Water! Everywhere, But not a drop to drink!
    - Dip into Water molecule pool- For kid's area.
    - Electrolysis
4. Inheritance
    - Mendel's Pea experiment.
    - Check the rarity of your traits.

5. Forensic science (Archaeology)

6. Biometrics (DNA Finger printing)
    - Genetic Song
7. Evolution
8. Mineralization

- Mineralization of Volcanic rocks and minerals

9. Cell Division
    - Rate of cell division after and before birth.
    - Gestation Period
    - Mitosis and Meiosis
    - Cell division analogy
10. Tsunami
    - Simulation of Tsunami

11. Faults and Folds
    - Folding the earth crust.

Shortlisted & Finalized Exhibits

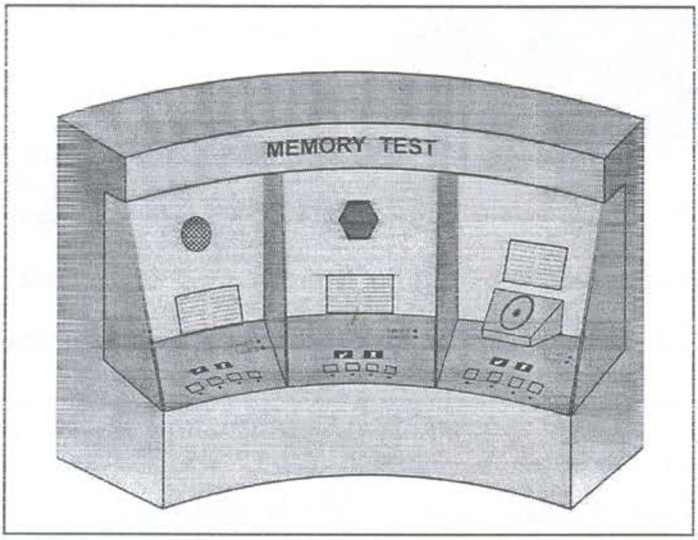
Group – A

Participants:

1. *SUBHASHIS DAS*
2. *VIKRAMJEET SINGH ARORA*
3. *DR. RAJ MEHROTRA*
4. *R. MANIGANDAN*
5. *KAMALABH KUMAR SINGH*
6. *DR. R. SRINIVASAN*

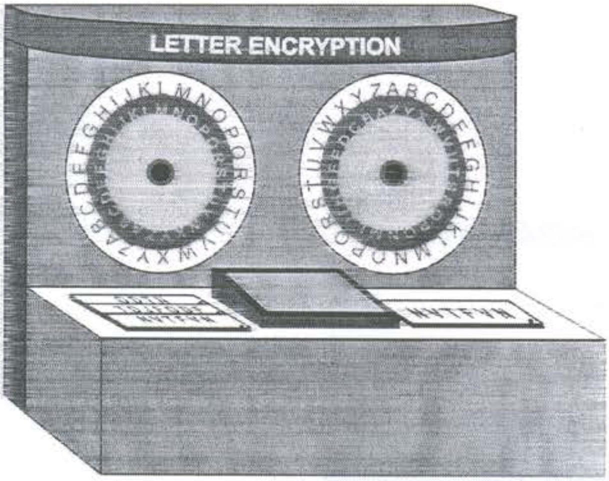
Selected Exhibits

1. MEMORY TEST (GROUP : MEMORY)



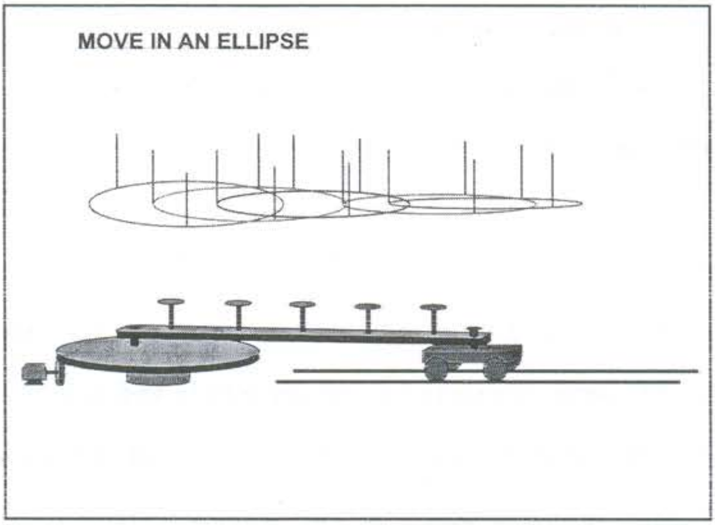
The exhibit shows human memory for events occurring in sequence. On pressing START switch, visitor can hear 4 different instrumental sounds in a sequence which he has to retrieve by pressing the corresponding switches in the same order (Auditory Memory). Next he sees 4 colored lights glowing in a random sequence, which he has to remember by pressing the corresponding switches (Visual Memory) in correct order. Likewise, he can test his memory (Touch Memory) for different hidden objects by touching them with his palm. It is found that most of the times, he can retrieve his visual memory for color correctly compared to other memory.

2. LETTER ENCRYPTION (GROUP: ENCRYPTION)



Here, visitor can create simple letter encryption by rotating 2 concentric vertical wheels on left side of the wall, each containing the English alphabets, and match letters of the outer wheel with that of the inner wheel for coding. For example, he can code the letter 'A' with the letter 'B', 'B' with 'C', 'C' with 'D' and so on. By rotating the wheels for a different match, different encryptions can be formed. Thus, setting B for A, next C for A and then Z for A, visitor can try to decode the encrypted words on the table. He can check by lifting the flap for the actual words. With the wheel on the right side, visitor can enjoy a more difficult encryption, where Z codes for A, Y for B, X for C and so on. At the centre, visitor can create the letter encryption on a touch screen monitor.

3. MOVE IN AN ELLIPSE (GROUP: ECCENTRICITY)



In this exhibit, motion of a circular disc in a slider crank mechanism generates elliptical paths of different eccentricities at different points on the connecting rod. Visitor can be seated on stools at 3 or 4 positions on the connecting rod of a large slider crank mechanism of 2.5 to 3m crank diameter, and move in elliptical paths of eccentricities 0.8, 0.7, 0.6, 0.5 & 0.4 as the crank disc is rotated horizontally on the floor with a friction drive. Looking at the hanging elliptical shaped large wire rings (of different eccentricities), visitors can appreciate the elliptical paths they move along.

4. EQUAL TEMPERAMENT SCALE (GROUP: SCALE)

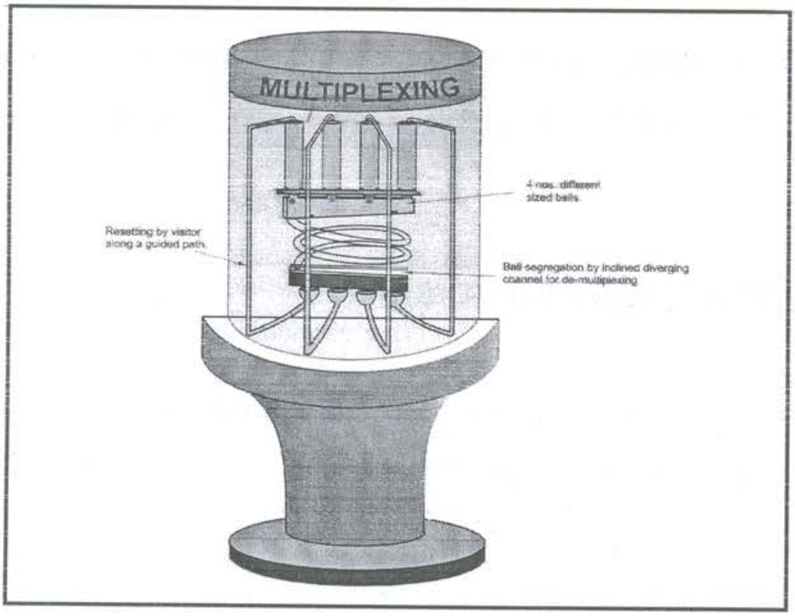
Musical scales are Equal Temperament Scales. Here, on left side of the exhibit, 13 solid slabs of granite or aluminium are arranged from length of 400 mm to 570 mm in linear scale. On the right side, another set of 13 slabs are arranged from 400 mm to 570 mm, but according to Equal Temperament Scale, i.e. 2nd slab with $400x2^{(1/24)}$, 3rd with $400x2^{(2/24)}$, 4th with $400x2^{(3/24)}$ and so on). While the former arrangement does not yield any melodious tune, the latter does so on hitting the slabs with a nylon hammer.

(The prototype of this exhibit was made in the CRTL workshop using solid aluminium rod of 12 mm diameter. The exhibit is expected to work well with 8 nos. rods (for Major Tunes only) instead of 13 nos. in the musical scales.)

Instructions:

- There are 2 sets of granite slabs (13 nos. each) on two frames. Use the hammer provided to strike the slabs one by one gently and hear the sound generated.
- In the right frame, the slabs are producing a melodious tune on striking, while in the other set, the sound generated is not so. Why?
- Sound generated by the slab depends on the length. The lengths of the slabs in the right frame are in equal temperament scale followed in music. On the other hand, the lengths of the slabs in the other set are in linear scale.

5. MULTIPLEXING (COMMUNICATIONS)


MULTIPLEXING
4 nos. different sized balls.
Resetting by visitor along a guided path.
Ball segregation by inclined diverging channel for de-multiplexing

This is a mechanical analogy of communicating parameters of many signals from sender's end by multiplexing, and then de-multiplexing them for sending them to receivers.

GROUP B

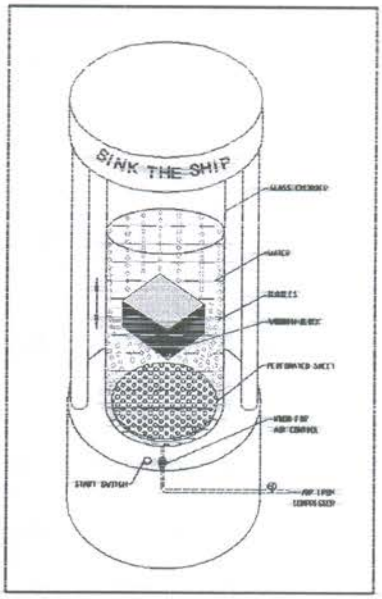
Participants:

1. *SHRI PRABAL ROY, PC, RSC, BHOPAL*
2. *SHRI UMESH KUMAR, CURATOR, NSC MUMBAI*
3. *SHRI MOINUDDIN ANSARI, DSO, DSC PURULIA*
4. *SHRI RAJESH BORALE, DSO, DSC, GULBARGA*
5. *SHRI SOUMEN GHOSH, PC, DSC DIGHA*
6. *SHRI SUKAYLAN CHAKRABORTY, MS FELLOW*

Selected Exhibits

1. BUOYANCY

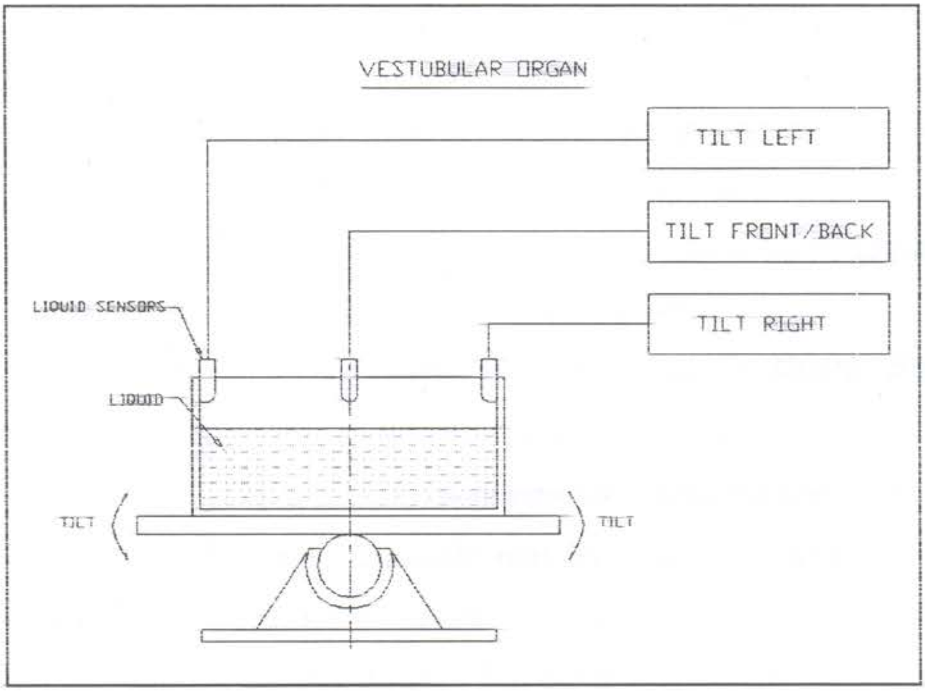
The exhibit is proposed to have a transparent cylindrical tank, in which a model of ship floats on water. Provision will be made to send air bubbles from the bottom of the tank Because of this bubbling, the average density of water will change, making it lighter. This reduces the weight of the displaced water and hence the buoyant force, causing the ship to sink.



2. VESTIBULAR ORGAN

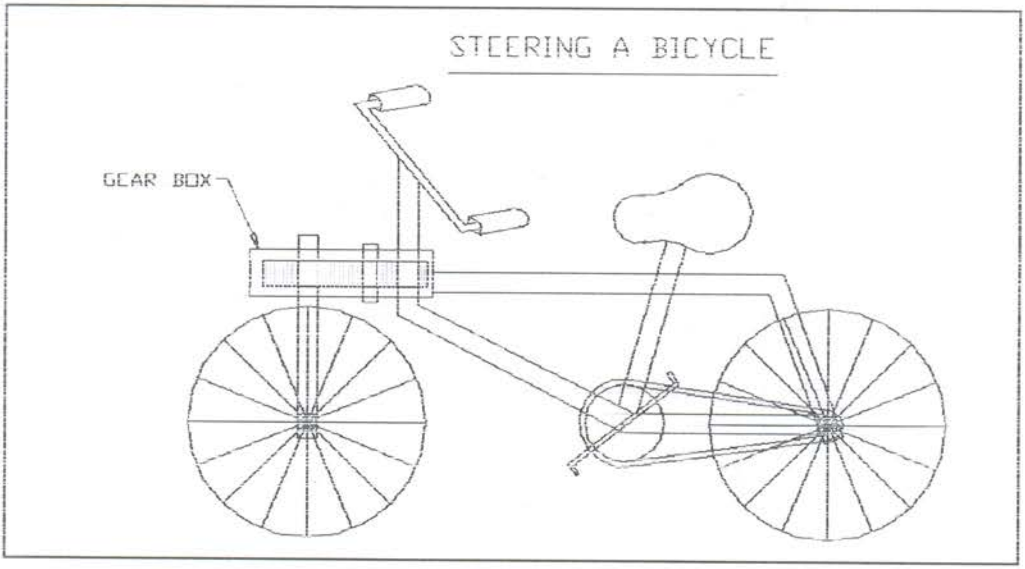
This exhibit will be a mechanical simulation of human balancing mechanism. A liquid in the inner ear detects the human body posture and in case of imbalance sends a message to the brain.

The exhibit is proposed to have a model of human body, showing the cut section of inner ear, where the liquid is present. Visitor can tilt the human body model in different directions and the movement will be sensed electronically.

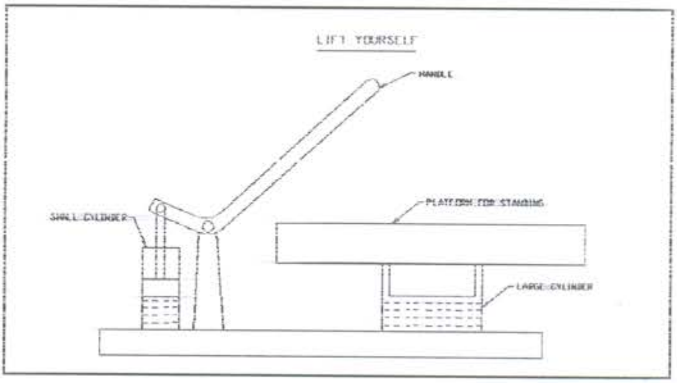


3. STEERING A BICYCLE

Visitor will be allowed to ride a bicycle, which will be having a special steering with gear arrangement. The angle at which the wheel turns will not be same as the angle of turn of the handle. This will make the rider difficult to balance him.



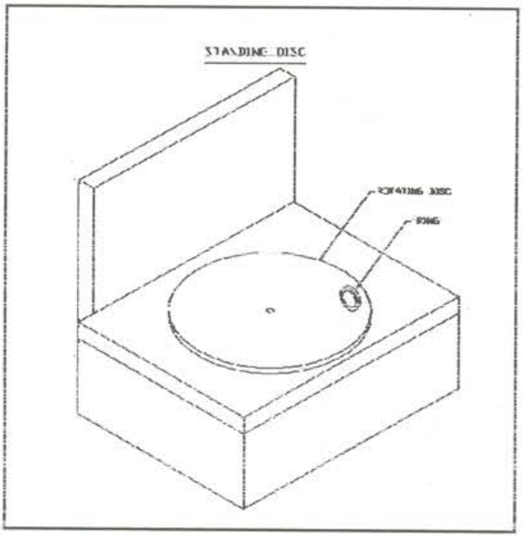
4. LIFT YOURSELF



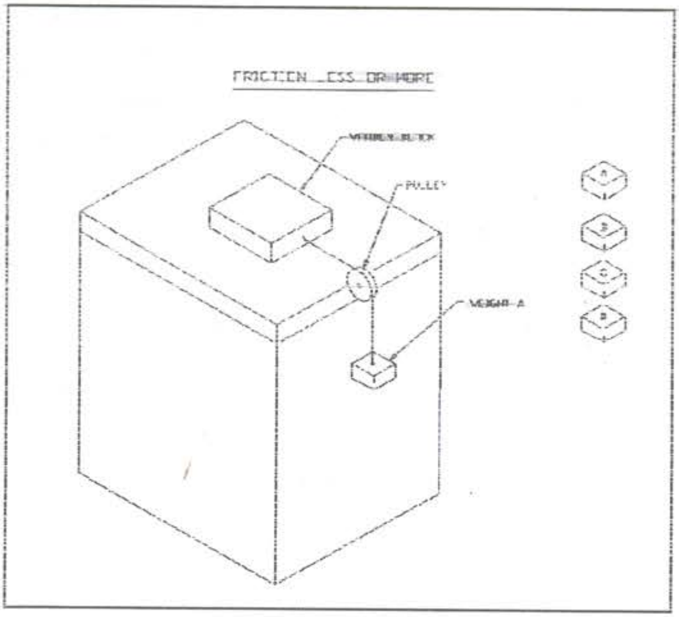
The exhibit will be having a hydraulic pump with a base on which visitor can stand and do the pumping action. With each stroke the visitor will be lifted up. This exhibit explains Pascal's law.

5. STANDING DISC

The exhibit will be having a 2' rotating platform. Visitor will be required to make the smaller discs standing, on its edge, on the rotating platform. It will need little skill to make them standing by using the concepts of the centrifugal force and gyration.



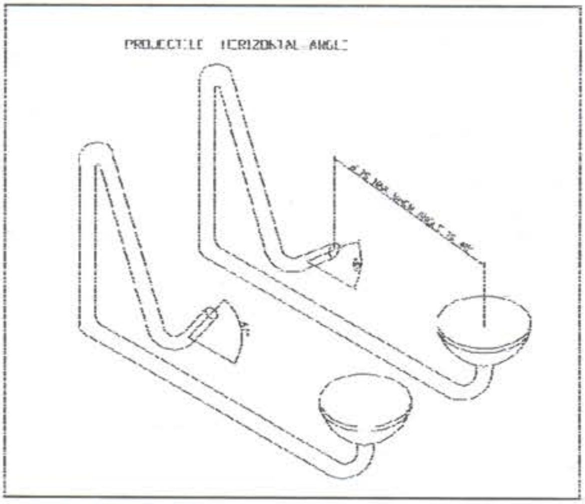
6. FRICTION : LESS OR MORE



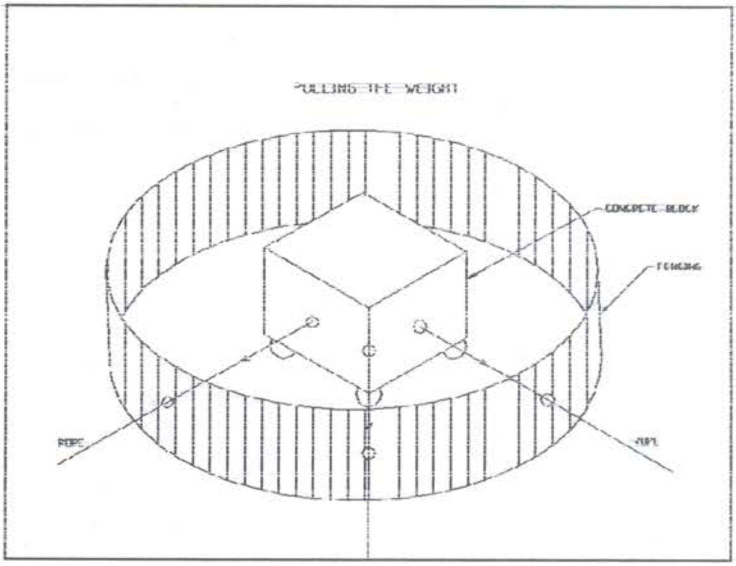
It is proposed to have a wooden/ metal rectangular block, which will be pulled just to slide on a smooth surface. Visitor will be able to slide the block on its three different sides. The common perception is, more the area of contact, more will be the frictional force. But in reality, the frictional force is independent of area of contact.

7. PROJECTILE : HORIZONTAL RANGE

This will have three tracks in which three balls will be released from the same height. These balls will be allowed to escape from the bottom of tracks at different angles. There will be three baskets to collect the balls reaching various horizontal range. It will be observed that the ball going at 45 degree will attain maximum horizontal range.

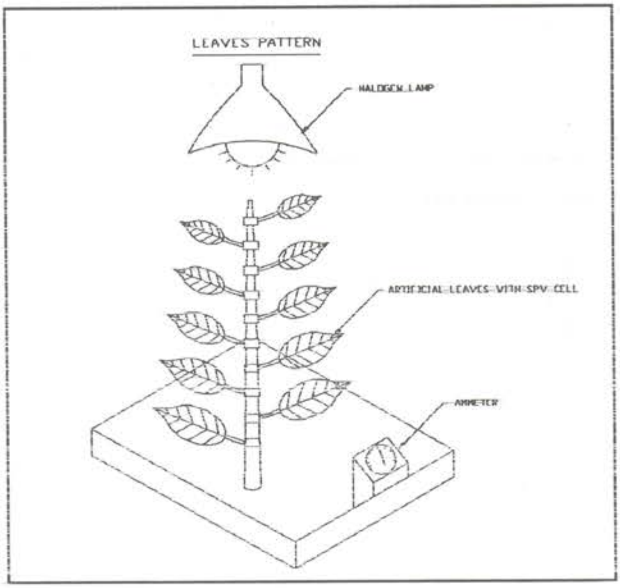


8. PULLING THE WEIGHT



This exhibit is a different version of the garden exhibit titled 'Tug of war'. In this exhibit, two visitors pull a weight at right angle to each other. A third visitor 9child) can pull the same weight in a direction which will be in the direction of the resultant force applied by other two visitors. (Parents) In this proposed family game, the child will always be the winner.

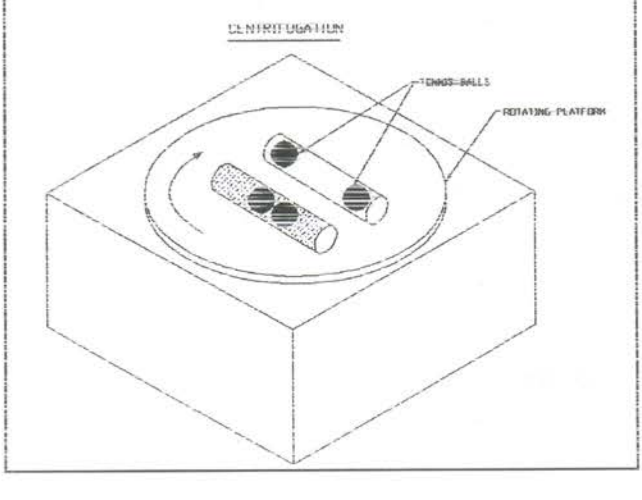
9. LEAF PATTERN



There will be series of artificial leaves mounted with either solar cells/LDRs to sense the amount of light received from a lamp placed on the top of plant of which artificial leaves are parts. Visitor can arrange the leaves in some patterns like alternate, opposites etc to observe in which arrangement of leaves the light received is maximum. The same will be compared with leaves pattern in nature.

10. CENTRIFUGATION

The exhibit has two transparent tubes, placed on two discs which can be rotated. One of the tubes is filled with water. Each tube has two lawn tennis balls. When the disc is rotated with the tubes, the balls in the tube containing water comes to the middle of the tube, while in the other tube the balls always remain at its ends.



Group – C

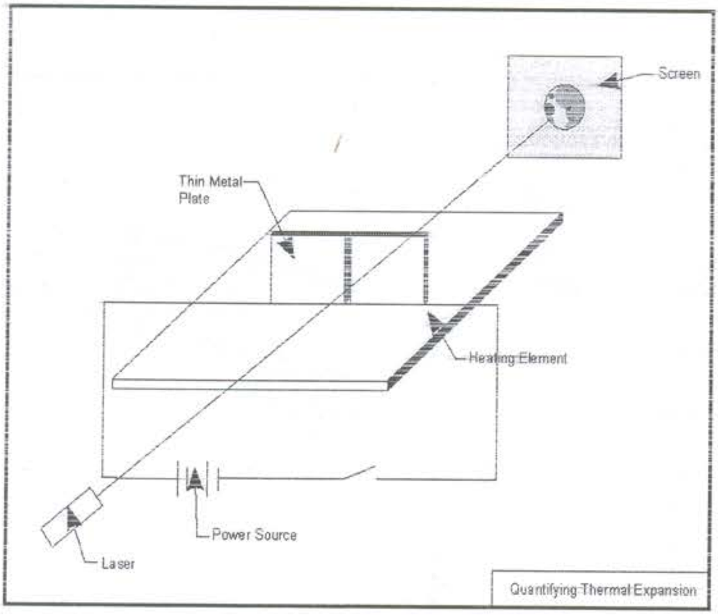
Participants:

1. *DR KANCHAN KUMAR CHOUDHURY*
2. *SAJOO BHASKARAN*
3. *BASUDEB MONDAL*
4. *SUJOY MAZUMDER*
5. *FAHD MD. A AL-BARRAQ*
6. *KRISHNENDU CHOUDHURY*

Selected Exhibits

1. QUANTIFYING THERMAL EXPANSION

Two thin metal plates will be placed side by side with a small gap between them. The plates can be heated electrically. A laser beam passing through the gap makes diffraction pattern on a screen. As the plates are heated, the size of the gap changes thus changing the diffraction pattern.

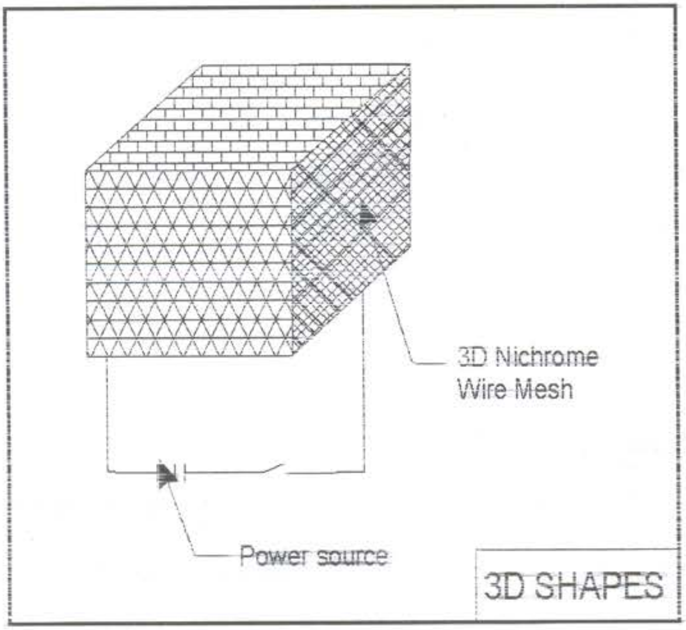


Quantifying Thermal Expansion

2. 3D SHAPES

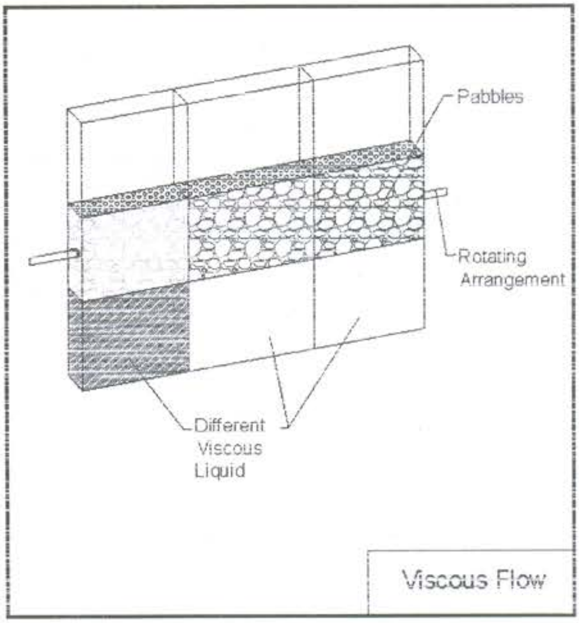
Press the switch to heat the wire mesh. The mesh glow red hot and sags.

The mesh when heated expands and this causes the sag.



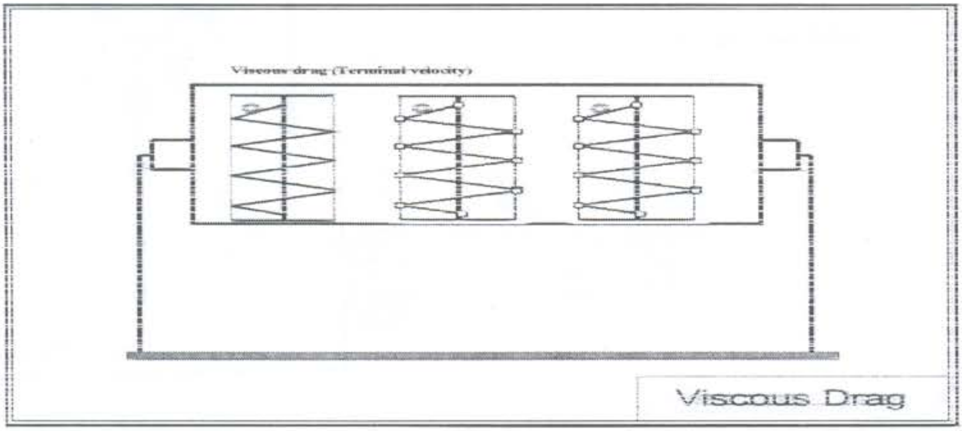
3. VISCOUS DRAG

Rotate the cylinders. Observe that the ball in one cylinder rolls down faster. The cylinders are filled with different liquids. Any liquid exerts a force against the direction of movement. This force is called viscous drag. Higher the viscosity, higher will be the viscous drag, and slower will be the motion.



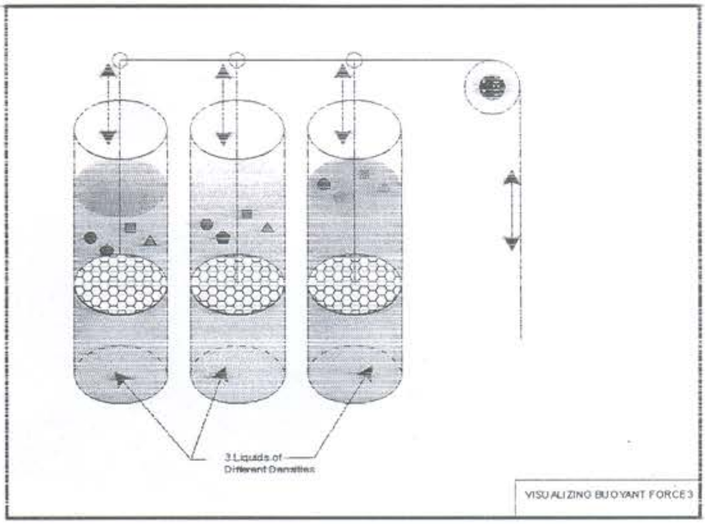
4. VISCOUS FLOW

Rotate the containers to allow the liquid to flow down the gaps between the irregular shapes. Observe that the liquid in one container rolls down faster. This liquid has a lesser viscosity than the liquids in the other containers.



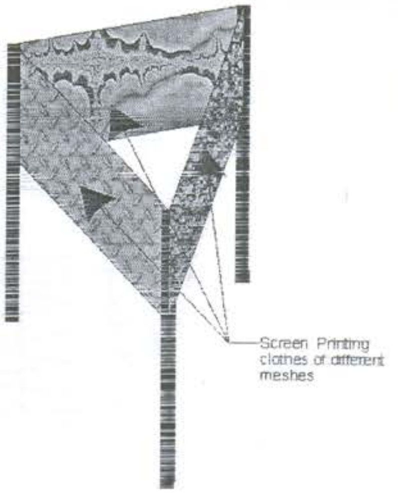
5. VISUALIZING BUOYANT FORCE

Objects of different shapes are kept on a perforated disc floating in a liquid inside an acrylic cylinder. When the perforated disc is lowered, the objects may float or sink depending on the force acing on them. It will indicate the effect of buoyancy. Three acrylic cylinders with liquids of different density will be used.



6. DUCK IN DIFFRACTION BOX

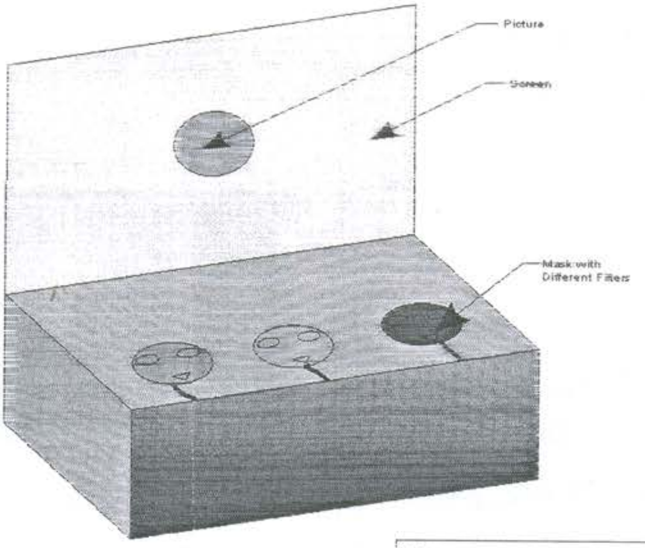
This exhibit contains a triangular enclosure whose three faces are covered with screen printing cloth of different mesh size. Visitors can duck into this enclosure and look through these screens to see the beautiful diffraction patterns.



DUCK in DIFFRACTION BOX

7. HOW ANIMALS SEE COLOR

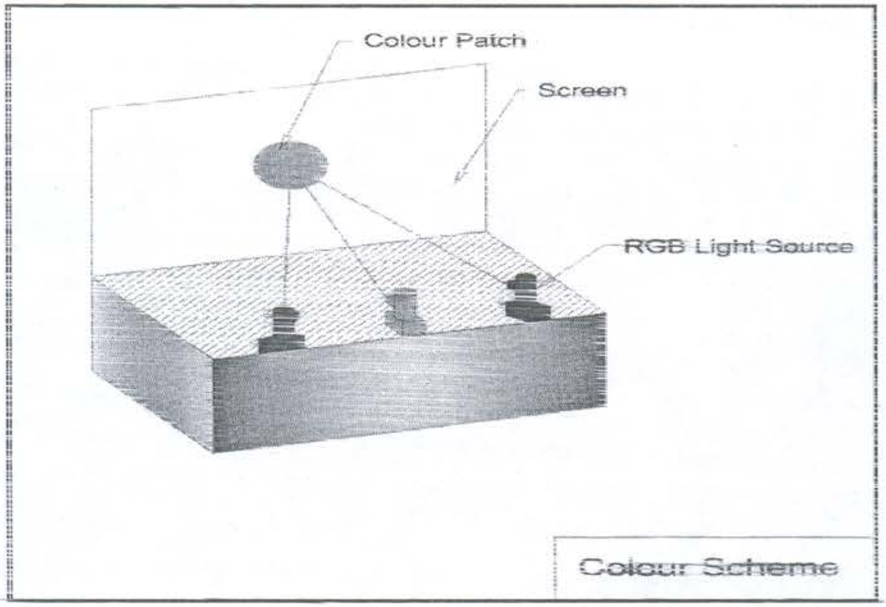
See through the masks and feel how different animals see their world around.



HOW ANIMAL SEE COLOUR

8. COLOR SCHEME

Rotate the knobs to change the intensity of Red, Green & Blue lights falling on the screen. Note the change in the resultant shade. Different color shades can be derived by mixing Red, Green and Blue in appropriate proportion.



Colour Scheme

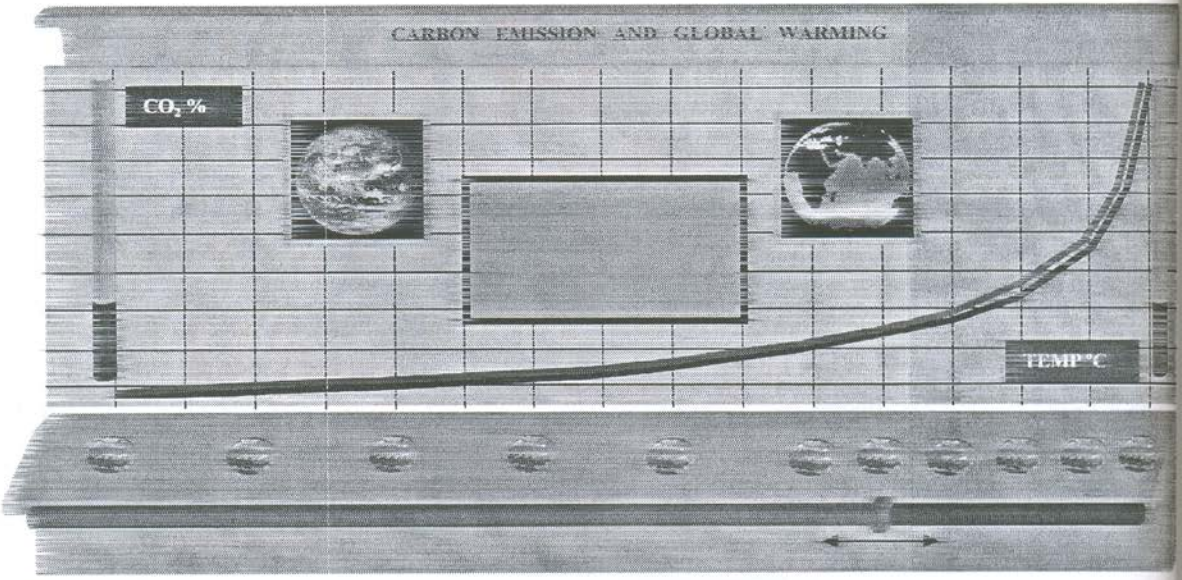
GROUP – D

1. *NATARAJ DASGUPTA, CURATOR, CRTL*
2. *PROMOD GROVER, CURATOR, SCIENCE CITY*
3. *MANASH BAGCHI, CURATOR, NSCD*
4. *JYOTI MEHRA, CURATOR, VITM*
5. *BASHEER MD. HUSSEIN AL-BOTAILY, NSM, YEMEN*

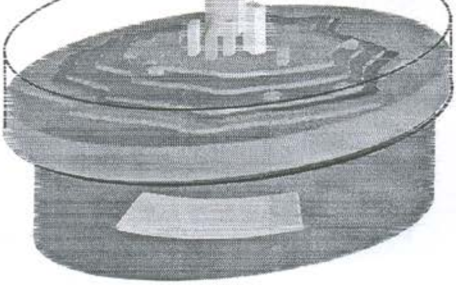
Selected Exhibits:

1. CARBON EMISSION AND GLOBAL WARMING

A timeline of Carbon emission level in atmosphere and global warming will be presented through a relief graph model. A graphical representation will be depicted in Time vs. Carbon Emission level and its consequence as global warming. Visitor will be taking a hoop along an animated time scale; corresponding to which the animated plot will show the level CO_2 and corresponding temperature rise. Across this plot at certain intervals of time we have some significant zones. The moment the hoop reaches these zones with iconic display; an information display will be activated to show the cause of CO_2 level rise or fall and its implications.



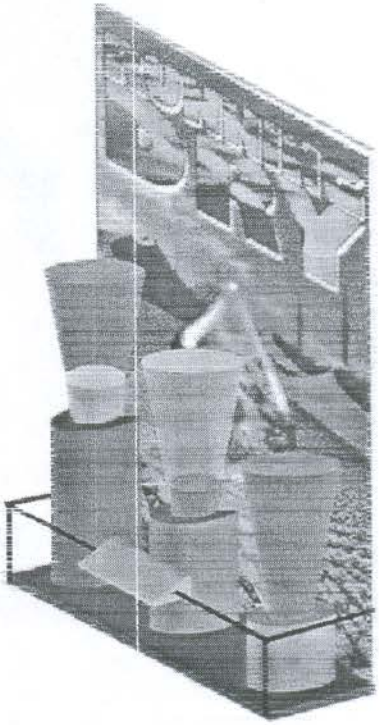
2. SEA LEVEL RISE



A 3D cityscape surrounded by sea water is made in the form of a model of the landmass topography and the cityscape placed on a water filled sink. Visitor is allowed to slide a pointer for a time period of consideration and the water level denoting the sea level with incorporation of actual data of sea level rise. Future projections will also be incorporated to emphasize the impact of sea level rise in future.

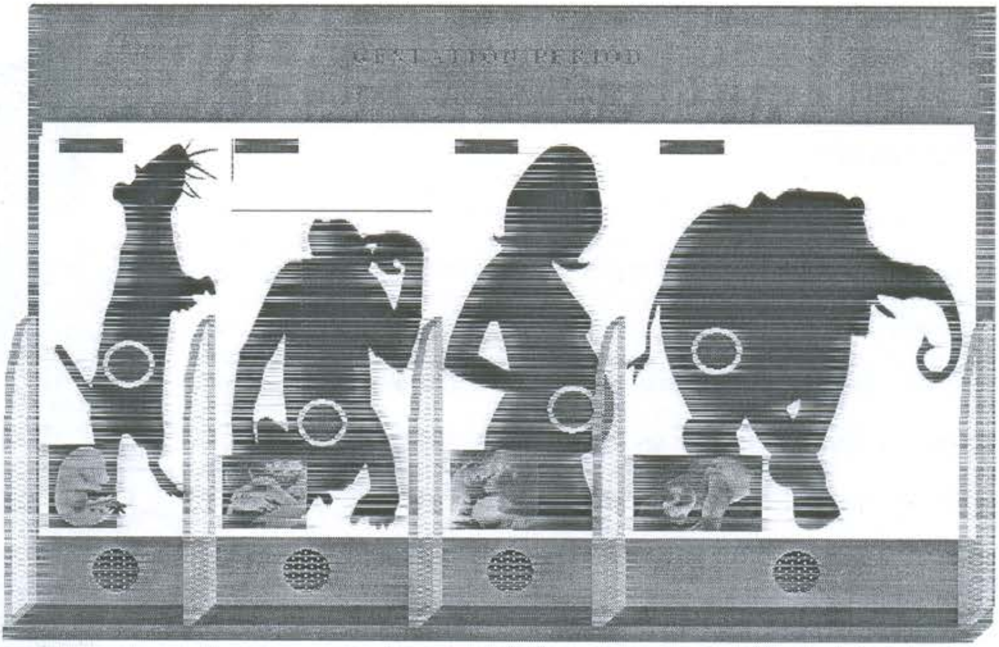
3. WATER! WATER! EVERYWHERE, BUT NOT A DROP TO DRINK!

A big glass container in tumbler shape filled with water which indicates the total water content of the earth. 4 to 5 buttons will be provided to know the global distribution of water. Pressing each button will lead to drain proportion of water corresponding to sea, ground, glacial etc. Visitor will see almost no water is left to drink at the end. The distribution of water is further scaled by providing two more identical containers for better understanding of distribution pattern. Conserve or Waste – It is now your choice!

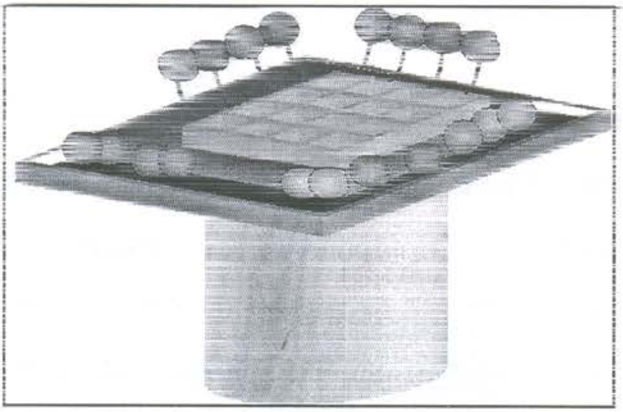


4. GESTATION PERIOD

This exhibit shows gestation period of mammals (4 different mammals including rat, elephant, human and chimpanzee). Corresponding to display of relief model/silhouette of those mammals, there will be pockets on their tummy. Visitor can pull out and stretch a rope (in the form of umbilical chord) from those pockets until the baby corresponding to the mammal starts crying, indicating the baby took birth. A provision of rope unwinding will be there to display digitally the gestation period in days along with visuals of different stages in a digital frame for the respective mammals.



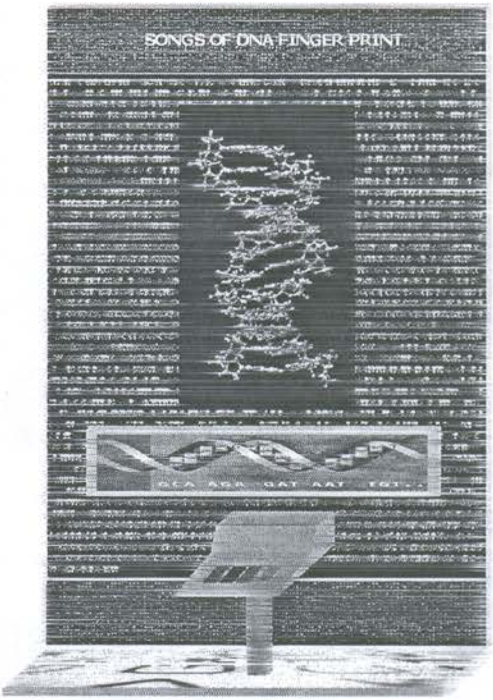
5. MENDEL'S PEA EXPERIMENT (LAWS OF HEREDITY)



An interactive exhibit on Mandel's Pea experiment will be presented incorporating two generations, i.e., F1 and F2. The exhibit will be consisting of one 2x2 and one 4x4 3D matrix for 2nd and 3rd generation respectively along with a bucket full of balls (about 100 mm dia.) of different colour & shape combination. The balls will be with separate RF ID corresponding to different genetic characters of the peas (1:2:1 and 9:3:3:1 in 2nd generation). Visitors will have to fill the grid with the balls understanding the recessive and dominant characters passing through the generations. If one is not able to choose the right combination, a massage will be displayed to choose another ball.

6. SONGS OF DNA FINGER PRINT

As our DNA consist of four nucleotides A, T, G & C. Corresponding to all four of these, four different notes(Sa, Ga, Pa, Sa) will be associated in a way that when we press different buttons corresponding to different bases, it will produce music accordingly. So visitor will find that changing the combination of these nucleotides by pressing switches corresponding to the A, T, G & C he can compose a new music. In the same way, in our body, corresponding to different sequence of these nucleotides, different characters appear.



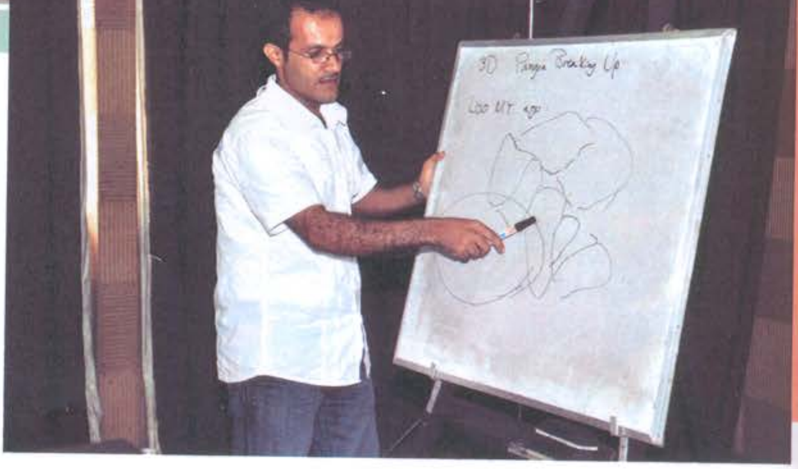
Resolutions

The workshop resolved that:

1. The exhibits, for which design has been finalized, will be developed by participants at different NCSM units.
2. The experimentations will be conducted by participants at different NCSM units for the exhibits for which still there is scope of further perfection and improvement of design.
3. CRTL will organize similar workshops in future in order to encourage creativity and to enrich professional knowledge of the Curators.
4. CRTL will publish proceedings of the workshop.

Photo Gallery

Photo Gallery



NOTES

For further information, please contact:

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